

ORIGINAL ARTICLE

Dose–response relation between physical activity and sick leave

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Br J Sports Med 2006;40:173–178. doi: 10.1136/bjsm.2005.022327

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Accepted
27 September 2005

Objective: To investigate the dose–response relation between moderate and vigorous physical activity and sick leave in a working population.

Methods: Data were used from three large Dutch databases: two continuous, cross sectional surveys among a representative sample of the Dutch population and one prospective cohort study. A distinction was made between duration, frequency and intensity of physical activity. The outcome measure was the number of days of sick leave. Analyses of variance were used to compare sick leave (in days) for workers with different amounts of physical activity, in particular workers meeting the physical activity recommendations v those who did not. Linear and logistic regression analyses were used to obtain effect estimates in the prospective cohort study, with the generalised estimating equation (GEE) method.

Results: No relation was found between moderate physical activity and sick leave. In two databases, workers meeting the recommendation of vigorous physical activity (active at a vigorous level for at least three times a week) had significantly less sick leave: more than one day over two months and more than four days over a year. The duration of vigorous physical activity was not associated with sick leave.

Conclusion: Physical activity at a vigorous intensity level for at least three times a week, as in the CDC/ACSM recommendation, has a positive effect on sick leave.

The evidence for positive health effects of physical activity is strong. People who are physically active on a regular basis obtain a wide array of health benefits compared with those who are inactive.^{1–8} Next to effects on health, the evidence for a positive effect of physical activity on work related outcomes is growing. Results of a prospective study showed that, over a period of four years, workers who engaged in sports had 20 days less sick leave compared with non-sporting workers.⁹ In addition, a recent cross sectional study reported a significant association between physical activity and work performance.¹⁰ The indirect costs (that is, the costs in (un)paid labour as a consequence of illness, injury related disability, or premature death) caused by physical inactivity are enormous and largely exceed the direct health care costs. An analytical review estimated that the total economic burden of physical inactivity in Canada was \$5.3 billion, of which two thirds (\$3.7 billion) was spent on indirect costs.¹¹

All these consequences call for “action”—that is, the promotion of physical activity. The question remains as to how much physical activity is needed to achieve benefits. For developing and maintaining fitness effects, a training frequency of three to five days a week at an intensity level of 55/65% to 90% of maximum heart rate and a duration of 20 to 60 minutes of continuous or intermittent (minimum of 10 minute bouts accumulated throughout the day) aerobic activity is recommended.^{12–13} In addition, several studies have examined and found a dose–response relation between physical activity and health effects.^{14–15} Even if healthy adults do not meet these recommendations for vigorous intensity physical activity, current guidelines recommend that they should accumulate at least 30 minutes of moderately intensive activity on at least five days a week for health effects.^{16–17}

Effects on health can also lead to an effect on sick leave, which is a relevant outcome for business. However, the amount of physical activity necessary to obtain a decrease in sick leave is unclear, and recommendations on the minimum

amount of physical activity are lacking. Moreover, a probable dose–response relation between physical activity and sick leave or other work related outcomes has been little studied. To our knowledge, the relation between physical activity and work related outcomes has never been studied with a clear distinction in type, frequency, or duration of the activity. This specific information, however, is required to formulate an evidence based recommendation on the minimum or optimum amount of physical activity necessary to achieve work related benefits. Such recommendations are necessary to stimulate employers to implement worksite physical activity programmes and thereby contribute to both occupational and public health. Our aim in this study was to investigate the dose–response relation between physical activity and sick leave.

METHODS

Data sources

Data were used from three large Dutch databases: OBiN, POLS, and SMASH.

OBiN (Ongevallen en Bewegen in Nederland; translated in English: Injuries and Physical Activity in the Netherlands) is a continuous, cross sectional survey among a representative sample of the Dutch population of at least 12 years of age. For the purpose of this study, data from the years 2000 to 2003 were used. Each year, 10 000 persons were interviewed by telephone about all kinds of injuries. About three quarter of the study population were asked about physical activity in general (that is, meeting the current health related physical activity recommendations) and approximately one quarter

Abbreviations: MET, metabolic equivalent; OBiN, Ongevallen en Bewegen in Nederland (Injuries and Physical Activity in the Netherlands); POLS, Permanent Onderzoek LeefSituatie (Permanent Study Living Conditions); SMASH, Study on Musculoskeletal disorders, Absenteeism, Stress and Health; SQUASH, Short Questionnaire to Assess Health-Enhancing Physical Activity

Table 1 Description of the study population per survey

	OBiN (n = 5070)	POLS (n = 8993)	SMASH (n = 1593) (5895 observations)
Sex (% male)	54.6%	59.0%	70.1%
Age (years)	40.2 (11.5)	38.5 (11.5)	37.0 (8.8)
Meeting moderate intensity physical activity recommendation*	44.8%	50.2%	–
Meeting vigorous intensity physical activity recommendation†	28.1%	17.5%	12.7%
Duration of moderate intensity physical activity (min/day)‡	76.0 (134.7)	97.3 (120.8)	–
Duration of vigorous intensity physical activity (min/day)	39.8 (99.6)	16.4 (37.1)	–
Sick leave			
% Sick leaves§	22.3%	22.9%	75.0%
% Long term sick leave¶	–	–	28.5%
Duration sick leave (days)**	2.3 (8.3)	2.3 (7.8)	23.6 (31.5)

Values are mean (SD) or per cent.

*Active at a moderate level for at least 5 days per week, in a subpopulation of workers not meeting the vigorous activity recommendation.

†Active at a vigorous level for at least 3 times per week.

‡In subpopulation of workers not meeting the vigorous activity recommendation.

§Sick leave in the last two months (OBiN, POLS) or in the last 12 months (SMASH).

¶Long term sick leave: more than 21 sick leave days on average per year (SMASH).

**Sick leave days in the last two months (OBiN, POLS) or in the last 12 months (SMASH).

OBiN, Ongevallen en Bewegingen in Nederland (Injuries and Physical Activity in the Netherlands); POLS, Permanent Onderzoek LeefSituatie (Permanent Study Living Conditions); SMASH, Study on Musculoskeletal disorders, Absenteeism, Stress and Health.

was asked more detailed questions as to their participation in physical activities.

POLS (Permanent Onderzoek LeefSituatie; translated in English: Permanent Study Living Conditions) is also a large continuous, cross sectional survey among a representative sample of the Dutch population. For the purpose of this study, data from the years 1997 to 2002 were used. The POLS survey included questions about all kinds of topics related to lifestyle, which were mainly completed through computer assisted personal interviewing. The health related section of the survey included a written questionnaire. The yearly total number of respondents varies from 20 000 to 80 000. However, not all respondents were approached for all sections of the survey. For the “Health and Work” part of the survey, approximately 4000 respondents (aged 18 to 64 years) were available per year. In both OBiN and POLS, participants were informed that their privacy was guaranteed as laid down by law.

SMASH (the Study on Musculoskeletal Disorders, Absenteeism, Stress and Health) is a three year (1994 to

1997) prospective cohort aimed at examining work related risk factors for musculoskeletal disorders. At baseline, the study population consisted of 1789 workers from 34 companies, located throughout the Netherlands.

The study was approved by the medical ethics committee of the Netherlands Organisation for Applied Scientific Research (TNO).

Assessment of physical activity

Four physical activity measures were used. The first two were derived from the recommendations of the Centers for Disease Control and Prevention and the American College of Sports Medicine,^{13 16 17} hereafter called the CDC/ACSM recommendations. They included the frequency (in days per week) of having been active at a moderate level for at least 30 minutes a day, and the frequency (in times per week) of having been active at a vigorous intensity for at least 20 minutes per session. Two further variables were created, indicating the total amount of moderate intensity physical activity and the total amount of vigorous intensity activity, both expressed in

Table 2 Days of sick leave* for workers meeting the activity recommendations versus those who did not meet the recommendations

	OBiN (n = 5070)	POLS (n = 8993)	SMASH (n = 1593) (5895 obs)
Meeting moderate intensity physical activity recommendation†			
Yes	2.34 (8.48)	2.40 (8.15)	–
No	2.18 (7.88)	2.21 (7.81)	–
Meeting vigorous intensity physical activity recommendation‡			
Yes	1.85 (7.11)	1.89 (7.19)	17.97 (32.99)
No	2.43 (8.58)§	2.31 (7.98)	22.08 (40.35)§

Values are mean (SD).

*Sick leave in the past two months (OBiN, POLS) or in the past 12 months (SMASH).

†Active at a moderate level for at least 5 days per week, in subpopulation of workers not meeting the vigorous activity recommendation.

‡Active at a vigorous level for at least 3 times per week.

§p < 0.05.

OBiN, Ongevallen en Bewegingen in Nederland (Injuries and Physical Activity in the Netherlands); POLS, Permanent Onderzoek LeefSituatie (Permanent Study Living Conditions); SMASH, Study on Musculoskeletal disorders, Absenteeism, Stress and Health.

minutes per day. These two variables were created by adding up the duration of physical activity across several domains (for example, sports, chores, gardening).

Because three different surveys were used, the questions differed somewhat. In OBiN, three quarters of the respondents were asked about the frequency with which they had usually carried out moderate activities for 30 minutes or more a day in the past summer and the past winter. For vigorous activity, they were asked about the frequency with which they usually carried out vigorous activities for at least 20 minutes a session in the past summer and the past winter. Moreover, one quarter of the respondents were asked about their participation (duration, in minutes) in moderate and vigorous intensity activity while doing each of the following on the day preceding the interview: commuting, carrying out school and work activities, engaging in sports, walking, cycling, gardening, doing household chores, or undertaking other sources of physical activity.

In POLS, physical activity was measured using the short questionnaire to assess health-enhancing physical activity (SQUASH), which had proved to be a fairly reliable and reasonably valid questionnaire.¹⁸ In SQUASH, questions were asked about the following: commuting activities (walking and cycling); leisure time activities (walking, cycling, gardening, chores, and sports); household activities; and activities at work and school. For each type of activity, questions were asked about duration (average time per day), frequency (days per week), and intensity (slow, average, fast). Metabolic equivalent (MET) values were assigned to each type of activity and sports, according to the compendium of Ainsworth.¹⁹ Based on the MET value and self rated intensity, the intensity level was determined. Using the intensity level in combination with the self reported duration and frequency, all four variables were computed.

Using SMASH, the proportion of workers meeting the vigorous intensity physical activity recommendation was determined by means of the following question: "In the last four months, how often have you performed vigorous activities that took long enough for you to be covered in sweat?" A six point scale was applied, as follows: 1, none; 2, less than once a month; 3, about once a month; 4, two to three times a month; 5, once or twice a week; 6, three or more times a week. No questions were available to determine the total amount of moderate or vigorous activities.

Table 3 Days of sick leave in the past two months by frequency and duration of moderate physical activity

Moderate physical activity	OBiN	POLS
Frequency		
0 days a week	2.42 (8.42)	2.99 (8.86)
1–2 days a week	2.01 (7.39)	1.93 (7.25)*
3–4 days a week	2.35 (8.19)	2.17 (7.91)
5–6 days a week	2.38 (8.92)	2.27 (7.84)
7 days a week	2.62 (8.93)	2.47 (8.32)
Duration		
0 minutes a day	2.57 (9.09)	2.59 (8.50)
1–19 minutes a day	2.14 (8.11)	1.91 (6.87)
20–29 minutes a day	0.63 (2.75)*	1.98 (7.66)
30–59 minutes a day	2.56 (9.14)	2.16 (7.86)
60–89 minutes a day	1.93 (7.18)	2.59 (9.05)
≥90 minutes a day	2.32 (7.80)	2.51 (8.12)

Values are mean (SD).

Analyses were conducted among a subpopulation of workers not meeting the vigorous intensity physical activity recommendation.

* $p < 0.05$ when compared to the reference (most inactive) category.

OBiN, Ongevallen en Bewegen in Nederland (Injuries and Physical Activity in the Netherlands); POLS, Permanent Onderzoek LeefSituatie (Permanent Study Living Conditions).

Table 4 Days of sick leave in the last two months by frequency and duration of vigorous physical activity

Vigorous physical activity	OBiN	POLS
Frequency		
0 times a week	2.74 (9.27)	2.45 (8.13)
1 time a week	2.30 (8.27)	2.05 (7.81)
2 times a week	2.01 (7.56)*	1.92 (7.43)
3 times a week	1.72 (6.54)†	1.55 (6.06)†
4 or more times a week	1.96 (7.53)*	2.08 (7.77)
Duration		
0 minutes a day	2.39 (8.59)	2.46 (8.17)
1–19 minutes a day	1.95 (7.92)	1.92 (7.20)*
20–29 minutes a day	2.60 (7.27)	2.21 (8.82)
30–59 minutes a day	2.01 (7.20)	1.65 (6.57)†
60–89 minutes a day	2.68 (9.04)	1.65 (5.03)*
≥90 minutes a day	1.91 (7.16)	2.89 (10.12)

Values are mean (SD).

* $p < 0.05$, † $p < 0.01$ v the reference (most inactive) category.

OBiN, Ongevallen en Bewegen in Nederland (Injuries and Physical Activity in the Netherlands); POLS, Permanent Onderzoek LeefSituatie (Permanent Study Living Conditions).

Assessment of sick leave

In OBiN and POLS, sick leave was assessed using self-reports asking about the number of days one had been absent from work due to illness in the last two months. In SMASH, registered sick leave data were used. They were collected annually and specifically for the study.

Statistical analysis

Analyses were conducted among those working for at least 12 hours a week. Analyses of variance were used to compare mean sick leave duration between groups of workers with different levels of physical activity. Linear and logistic regression analyses were conducted to obtain effect estimates, adjusting for age, sex, educational level, body mass index (BMI), smoking status, and physical (in)activity during work.

The dependent variable, sick leave, was analysed as a continuous measure specifying the number of days the individual had been on sick leave (in the past two months (OBiN and POLS) or in the past year (SMASH)). For SMASH, sick leave was also analysed as a dichotomous measure indicating whether the individual had been on long term sick leave (>21 days/year) or not.

Physical activity was analysed using several categories. Consistent with the physical activity recommendations, frequency of moderate physical activity was categorised as 0–2, 3–4, 5–6, or 7 days a week, and duration was categorised as 0–29, 30–59, 60–89, or ≥90 minutes a day. Vigorous physical activity was classified into none, one, two, three, or four or more times a week, and 0–19, 20–29, 30–59, 60–89, or ≥90 minutes a day. The analyses with moderate intensity activity were conducted among those workers who did not meet the vigorous intensity recommendation in order to prevent workers meeting the vigorous intensity recommendation from being placed in the reference group.

The cross sectional analyses in OBiN and POLS were carried out using SPSS (version 12.0). All tests applied two sided significance levels of $p \leq 0.05$. The longitudinal analyses in SMASH were undertaken using the generalised estimating equation (GEE) method, with the Proc Genmod procedure in the statistical package SAS (version 9.1.2).

RESULTS

From OBiN and POLS, data on physical activity and sick leave were available for 5070 and 8993 workers, respectively.

Table 5 Adjusted* regression coefficients (unstandardised B) and 95% confidence intervals of days of sick leave by frequency and duration of moderate physical activity

Moderate physical activity	OBiN	POLS
<i>Frequency</i>		
0–2 days/week	Reference	Reference
3–4 days/week	0.34 (–0.44 to 1.13)	0.02 (–0.60 to 0.64)
5–6 days/week	0.33 (–0.43 to 1.10)	–0.13 (–0.76 to 0.51)
7 days/week	0.53 (–0.23 to 1.28)	–0.13 (–0.69 to 0.43)
<i>Duration</i>		
0–29 min/day	Reference	Reference
30–59 min/day	0.22 (–0.71 to 1.15)	0.00 (–0.59 to 0.59)
60–89 min/day	–0.49 (–1.46 to 0.48)	0.35 (–0.36 to 1.06)
≥90 min/day	–0.05 (–0.72 to 0.62)	–0.14 (–0.71 to 0.43)

Analyses were conducted among a subpopulation of workers not meeting the vigorous intensity physical activity recommendation.

*Analyses were adjusted for age, sex, education level, body mass index, smoking status, and physical (in)activity during work.

OBiN, Ongevallen en Bewegen in Nederland (Injuries and Physical Activity in the Netherlands); POLS, Permanent Onderzoek LeefSituatie (Permanent Study Living Conditions).

Table 1 presents the characteristics of the study population for each survey.

There were no differences in mean sick leave duration between those who met the moderate intensity recommendation and those who did not (table 2). For vigorous intensity activities, results from OBiN and SMASH showed significant reductions ($p < 0.05$) in the amount of sick leave in workers meeting the vigorous intensity activity recommendation (0.6 day over two months; 4.1 days over 12 months).

From table 3, it can be concluded that there was no dose–response relation between the frequency and duration of moderate intensity physical activity and sick leave duration.

Based on OBiN and POLS, a dose–response relation was shown between frequency of vigorous intensity activity up to a frequency of three times a week and sick leave duration (table 4). Workers not carrying out vigorous activity at all had on average the most days of sick leave (2.74 and 2.45 days), whereas those who were vigorously active three times a week had the least sick leave (1.72 and 1.55 days). Results of SMASH (data not shown because of the different categories used) showed a similar pattern: the mean sick leave duration per year was 24.44 days for workers who were active three

times a month or less, 17.66 days for those active once or twice a week, and 17.97 days for those active three or more times a week. A significant effect on sick leave was apparent among those who were active at least once or twice a week. No dose–response relation was shown for the duration of exercise. However, the results from OBiN and POLS were inconsistent in that OBiN showed no differences between the categories while POLS found beneficial effects on sick leave among those who were active for 30 to 89 minutes a day.

Based on the adjusted linear regression analyses, there were no significant differences in sick leave duration between the various frequency and duration categories of moderate physical activity (table 5).

With regard to vigorous intensity activities, the adjusted regression analyses in OBiN and POLS showed no statistically significant differences in sick leave duration between the frequency categories (table 6). However, in OBiN there was a trend indicating that the higher the frequency, the less the requirement for sick leave, while the longitudinal analyses (GEE) in SMASH did show a statistically significant effect of the frequency of vigorous intensity activity on sick leave. Workers who had been vigorously active at least once per

Table 6 Adjusted* regression coefficients (unstandardised B) and 95% confidence intervals of days of sick leave by frequency and duration of vigorous physical activity

Vigorous physical activity	OBiN	POLS	SMASH†
<i>Frequency</i>			
0 times/week	Reference	Reference	Reference
Once a week	–0.14 (–0.87 to 0.59)	–0.30 (–0.84 to 0.23)	–8.99 (–12.39 to –5.58)‡
Twice a week	–0.36 (–1.14 to 0.42)	–0.25 (–0.89 to 0.39)	–10.18 (–13.61 to –6.75)‡
3 times/week	–0.81 (–1.68 to 0.06)	–0.68 (–1.47 to 0.11)	–8.22 (–12.30 to –4.14)‡
≥4 times/week	–0.80 (–1.61 to 0.00)	0.01 (–0.62 to 0.63)	
<i>Duration</i>			
0–19 min/day	Reference	Reference	(No data available)
20–29 min/day	0.24 (–1.55 to 2.02)	0.02 (–0.76 to 0.80)	
30–59 min/day	–0.19 (–1.18 to 0.81)	–0.41 (–1.04 to 0.21)	
60–89 min/day	0.63 (–0.45 to 1.72)	–0.36 (–1.37 to 0.65)	
≥90 min/day	–0.55 (–1.31 to 0.22)	1.00 (–0.04 to 2.03)	

*Analyses were adjusted for age, sex, education level, body mass index, smoking status, and physical (in)activity during work.

†Categories of frequency vigorous physical activity in SMASH: none or less than once a month; (reference), 1–3 times a month, 1–2 times a week, ≥3 times a week.

‡ $p < 0.01$.

OBiN, Ongevallen en Bewegen in Nederland (Injuries and Physical Activity in the Netherlands); POLS, Permanent Onderzoek LeefSituatie (Permanent Study Living Conditions); SMASH, Study on Musculoskeletal disorders, Absenteeism, Stress and Health.

Table 7 Adjusted* odds ratio and 95% confidence intervals of long term sick leave (>21 days a year) by frequency of vigorous physical activity

Frequency of vigorous physical activity	SMASH
0 days a week	Reference
1 day a week	0.67 (0.57 to 0.80)
2 days a week	0.62 (0.52 to 0.75)
≥3 days a week	0.76 (0.60 to 0.96)

*Analyses were adjusted for age, sex, education level, body mass index, smoking status, physical (in)activity during work. SMASH, Study on Musculoskeletal disorders, Absenteeism, Stress and Health.

week had on average 8 to 10 days less sick leave a year than those not undertaking vigorous intensity physical activity for at least 20 minutes a session (table 6). Further, a significant interaction between vigorous activity and time was found, in that the effect on sick leave was greater with the passage of time. Also, significant interactions were found for education and physical inactivity during work: the effect of vigorous intensity physical activity on sick leave was greater among more highly educated workers compared with less educated workers, and among workers with sedentary work compared with those with physically active occupations.

For duration of vigorous intensity activity, no dose-response relation was observed with sick leave in either OBiN or POLS (table 6).

Table 7 shows the results of the GEE analyses for predicting the likelihood of long term sick leave. There was a significant effect of vigorous intensity on long term sick leave. Workers who undertook vigorous activity at least once a week were about 0.7 times less at risk of taking sick leave for 21 days or more than workers who had not done any of these activities at all (table 7).

DISCUSSION

Our aim in this study was to investigate the dose-response relation between physical activity and sick leave. With regard to frequency, our results showed no effects of physical activity at a moderate intensity level. However, a minor dose-response relation was found between vigorous intensity physical activity up to a frequency of three times a week and sick leave. A higher frequency seemed to increase sick leave. Possibly, increased levels of physical activity could lead to other (negative) effects, such as sports injuries. The threshold value of three times a week partly matches to the current vigorous intensity physical activity recommendation, which states that a healthy adult should undertake vigorous activities lasting at least 20 minutes a session at a frequency of at least three times a week in order to develop and maintain fitness.¹²

Our finding that vigorous activity at three days a week may be effective at reducing sick leave is important information from an economical perspective for companies which decide to implement worksite physical activity programmes. It should be taken into account that the recommended frequency can be achieved by participation in a combination of all kinds of programmes and settings. This is relevant as the frequency of participation in company programmes is generally less than once a week, whereas our results indicate that a higher frequency is needed. The employer should also be aware of the long term benefits. From the analyses in SMASH, a significant interaction of time was found, indicating that the effect of vigorous activity on sick leave became greater with the passage of time. The few randomised studies on the effectiveness of work site physical activity

What is already known on this topic

There is evidence of a positive dose-response relation between physical activity and the prevention of adverse health effects.

What this study adds

There is an inverse dose-response relation between the frequency of vigorous intensity physical activity, up to a frequency of three times a week, and sick leave duration.

programmes on sick leave evaluated the effect in the short term (9 to 15 months) only.²⁰⁻²² As a result, and because of the inconsistent results found in those studies, there is at present only limited evidence for a positive effect of worksite physical activity programmes on sick leave.²³ Taking into account the interaction with time, it now seems possible that effects of initiatives to promote employees' physical activity will become apparent in the longer term. To provide evidence for a positive effect of these initiatives, randomised controlled studies using long term follow up are recommended.

Although the surveys involved large representative (OBiN and POLS) databases, there were some limitations to the present study. All surveys involved self reported physical activity data, which may have caused bias. Some respondents might have underestimated their participation in physical activity, whereas others might have given socially desirable answers, thereby overestimating their participation in physical activity. A study evaluating the overestimation of respondents showed that 33% estimated their physical activity behaviour incorrectly, and over 50% of the workers who did not meet the recommended level of physical activity overestimated their physical activity and reported that they were sufficiently active.²⁴ A study by Ronda *et al*²⁵ showed similar results: 61% of the workers who were active at a sufficient level overestimated their physical activity behaviour. Even though the physical activity questionnaires applied in OBiN and POLS have been shown to be fairly reliable and reasonably valid,¹⁸⁻²⁶ the problem of misclassification because of report bias cannot be excluded.

To avoid drawing conclusions from one database only, we used three different surveys. This, however, had the drawback that results were not entirely comparable owing to differences between the data sources. For example, the percentage of workers meeting the vigorous intensity physical activity recommendation ranged from 12.7% (SMASH) and 17.5 (POLS) up to 28.1% (OBiN).

From the results of this study, it can be concluded that (vigorously) active workers have less sick leave. However, it remains uncertain whether people are less physically active because they are less healthy, or whether physical activity has health effects that result in less sick leave. Although the associations shown in the longitudinal analyses reflect the between-workers relation as well as the relation between increased physical activity and decreased sick leave,²⁷ the extent to which these associations are caused by a within-worker or a between-worker relation remains unclear.

Conclusions

This study provided evidence for a dose-response relation between vigorous intensity physical activity and sick leave. It appeared that the greater the frequency, the less sick leave was taken. Above a threshold of three times a week, sick

leave duration increased slightly. Furthermore, the relation between vigorous intensity physical activity and sick leave increased with the passage of time. There was also a positive effect of vigorous intensity activities on long term sick leave (>21 days a year).

Though moderate physical activity will have health related effects, the results of the present study showed no evidence of a dose-response effect of moderate intensity physical activity on sick leave.

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Competing interests: none declared

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